CLAIMS

1. An electrochemical power generation system comprising:

a fuel cell stack comprising at least one fuel cell, an oxidant inlet, an oxidant outlet, a fuel inlet and a fuel outlet;

a fuel delivery system for delivering fuel to the fuel inlet of the stack;

an oxidant delivery system for delivering air from the ambient environment to the oxidant inlet of the stack;

an oxygen sensor for measuring the oxygen concentration of ambient air in the vicinity of the power generation system; and,

a controller coupled to the oxygen sensor and configured to cease operation of the power generation system when the oxygen concentration of the ambient air in the vicinity of the power generation system falls below an oxygen concentration threshold.

2. The electrochemical power generation system of claim 1 further comprising a purge valve associated with the fuel outlet, and wherein the controller is coupled to the purge valve and configured to intermittently open the purge valve such that the hydrogen discharged from the fuel cell stack during operation of the power generation system does not cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold.

3. The electrochemical power generation system of claim 2 wherein the controller is configured to intermittently open the purge valve such that the average continuous rate of hydrogen discharged from the fuel cell stack during operation of the power generation system does not exceed a critical hydrogen discharge rate that would cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold.

4. The electrochemical power generation system of claim 3 further comprising a hydrogen concentration sensor for measuring the hydrogen concentration in the ambient air in the vicinity of the power generation system, and wherein the controller is coupled to the hydrogen concentration sensor and is configured to cease operation of the power generation system when the hydrogen concentration measured by the hydrogen concentration sensor exceeds a hydrogen concentration threshold.

5. The electrochemical power generation system of claim 4 wherein the controller is configured to close the purge valve when the hydrogen concentration measured by the hydrogen concentration sensor exceeds the hydrogen concentration threshold.

6. The electrochemical power generation system of claim 4 wherein the hydrogen concentration threshold is 1%.

7. The electrochemical power generation system of claim 1 wherein the oxygen concentration threshold is 18%.

8. The electrochemical power generation system of claim 6 wherein the oxygen concentration threshold is 18%.

9. The electrochemical power generation system of claim 8 wherein the high hydrogen concentration condition corresponds to a lower flammability limit of hydrogen.

10. The electrochemical power generation system of claim 9 wherein the lower flammability limit is 4%.

11. The electrochemical power generation system of claim 4 further comprising a temperature sensor, wherein the controller is configured to cease operation of the

power generation system in response to a temperature reading exceeding a high temperature threshold.

12. An electrochemical power generation system comprising:

a fuel cell stack comprising at least one fuel cell, an oxidant inlet, an oxidant outlet, a fuel inlet and a fuel outlet;

a fuel delivery system for delivering fuel to the fuel inlet of the stack;

an oxidant delivery system for delivering air from the ambient environment to the oxidant inlet of the stack;

an oxygen sensor for measuring the oxygen concentration of ambient air in the vicinity of the power generation system;

a purge valve associated with the fuel outlet; and,

a controller coupled to the oxygen sensor and purge valve, and configured to cease operation of the power generation system when the oxygen concentration of the ambient air in the vicinity of the power generation system falls below an oxygen concentration threshold, and to intermittently open the purge valve such that the hydrogen discharged from the fuel cell stack during operation of the power generation system does not cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration falls below the oxygen concentration threshold value.

13. The electrochemical power generation system of claim 12 further comprising a hydrogen concentration sensor for measuring the hydrogen concentration in the ambient air in the vicinity of the power generation system, and wherein the controller is coupled to the hydrogen concentration sensor and is configured to cease operation of the power generation system when the hydrogen concentration measured by the hydrogen concentration sensor exceeds a hydrogen concentration threshold.

14. The electrochemical power generation system of claim 13 wherein the controller is configured to close the purge valve when the hydrogen concentration measured by the hydrogen concentration sensor exceeds the hydrogen concentration threshold

15. The electrochemical power generation system of claim 13 wherein the hydrogen concentration threshold is 1%.

16. The electrochemical power generation system of claim 12 wherein the oxygen concentration threshold is 18%.

17. The electrochemical power generation system of claim 15 wherein the oxygen concentration threshold is 18%.

18. The electrochemical power generation system of claim 17 wherein the high hydrogen concentration condition corresponds to a lower flammability limit of hydrogen.

19. The electrochemical power generation system of claim 18 wherein the lower flammability limit is 4%.

20. The electrochemical power generation system of claim 13 further comprising a temperature sensor, wherein the controller is configured to cease operation of the power generation system in response to a temperature reading exceeding a high temperature threshold.

21. A method of operating a fuel cell electrochemical power generation system comprising:

directing fuel to a fuel cell stack;

directing air from the ambient environment to the fuel cell stack for use as oxidant;

monitoring the oxygen concentration of the ambient air in the vicinity of the power generation system; and

ceasing operation of the power generation system if the monitored oxygen concentration falls below an oxygen concentration threshold.

22. The method of claim 21 further comprising intermittently discharging hydrogen from the fuel cell stack in a manner that does not cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold value.

23. The method of claim 21 further comprising intermittently discharging hydrogen from the fuel cell stack such that the average rate of hydrogen continuously discharged does not cause exceed a critical hydrogen discharge rate that would cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold value.

24. The method of claim 22 further comprising monitoring the hydrogen concentration in the vicinity of the power generation system, and ceasing operation of the power generation system if the hydrogen concentration exceeds a hydrogen concentration threshold.

25. The method of claim 24 wherein the hydrogen concentration threshold is 1%.

26. The method of claim 21 wherein the oxygen concentration threshold is 18%.

27. The method of claim 25 wherein the oxygen concentration threshold is 18%.

28. The method of claim 25 wherein the high hydrogen concentration condition corresponds to a lower flammability limit of hydrogen.

29. The method of claim 28 wherein the lower flammability limit is 4%.

30. The method of claim 23 further comprising monitoring the temperature of the power generation system, and stopping operation of the power generation system in response to a temperature reading exceeding a high temperature threshold.

31. A method of operating a fuel cell electrochemical power generation system comprising:

directing fuel to a fuel cell stack;

directing air from the ambient environment to the fuel cell stack for use as oxidant;

monitoring the oxygen concentration in ambient air in the vicinity of the power generation system and ceasing operation of the power generation system if the monitored oxygen concentration falls below an oxygen concentration threshold; and,

intermittently discharging hydrogen from the fuel cell stack in a manner that does not cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold.

32. The method of claim 31 further comprising monitoring the hydrogen concentration in the vicinity of the power generation system, and ceasing operation of the power generation system if the hydrogen concentration exceeds a hydrogen concentration threshold.

33. The method of claim 32 wherein the hydrogen concentration threshold is 1%.

34. The method of claim 31 wherein the oxygen concentration threshold is 18%.

35. The method of claim 33 wherein the oxygen concentration threshold is 18%.

35. The method of claim 31 wherein the high hydrogen concentration condition corresponds to a lower flammability limit of hydrogen.

36. The method of claim 35 wherein the lower flammability limit is 4%.

37. A computer-readable media containing instructions to cause a controller to control operation of a fuel cell stack by:

monitoring the oxygen concentration in ambient air in the vicinity of the fuel cell stack during operation of the fuel cell stack; and

ceasing operation of the fuel cell stack if the monitored oxygen concentration is less than an oxygen concentration threshold.

38. The computer-readable media of claim 37 containing instructions to cause a controller to control operation of the fuel cell stack, further by:

limiting the average rate of hydrogen continuously discharged from the fuel cell stack to not exceed a critical hydrogen discharge rate that would cause the hydrogen concentration in the vicinity of the power generation system to exceed a high hydrogen concentration condition before the oxygen concentration in the vicinity of the power generation system falls below the oxygen concentration threshold.

39. The computer-readable media of claim 37 containing instructions to cause a controller to control operation of the fuel cell assembly, further by:

setting the oxygen concentration threshold to approximately 18%.

40. The computer-readable media of claim 37 wherein the oxygen concentration is monitored periodically.

41. The computer-readable media of claim 37 wherein the oxygen concentration is monitored continuously.

42. The computer-readable media of claim 37 wherein the computer-readable media comprises a memory structure of a micro-controller.